20	76	5.8	440	7	US-11-796-730-3929	Sequence 3929, Ap
21	76	5.8	815	7	US-11-551-744-236	Sequence 236, App
22	75	5.8	269	7	US-11-796-730-2989	Sequence 2989, Ap
23	75	5.8	514	7	US-11-336-426-34	Sequence 34, Appl
24	74.5	5.7	616	6	US-10-574-194-39	Sequence 39, Appl
25	74.5	5.7	617	6	US-10-574-194-41	Sequence 41, Appl
26	74	5.7	828	7	US-11-417-216-10	Sequence 10, Appl
27	73.5	5.6	467	7	US-11-649-663A-3270	Sequence 3270, Ap
28	73	5.6	416	7	US-11-796-730-2732	Sequence 2732, Ap
29	72.5	5.6	356	6	US-10-438-246-8715	Sequence 8715, Ap
30	72.5	5.6	463	7	US-11-796-730-5223	Sequence 5223, Ap
31	72	5.5	234	7	US-11-796-730-2847	Sequence 2847, Ap
32	71.5	5.5	218	7	US-11-698-831-23	Sequence 23, Appl
33	71.5	5.5	238	7	US-11-796-730-3381	Sequence 3381, Ap
34	71.5	5.5	245	7	US-11-796-730-3580	Sequence 3580, Ap
35	71.5	5.5	489	7	US-11-796-730-2806	Sequence 2806, Ap
36	71.5	5.5	544	7	US-11-796-730-3538	Sequence 3538, Ap
37	71.5	5.5	1621	6	US-10-438-246-15843	Sequence 15843, A
38	71	5.5	389	7	US-11-788-342-54	Sequence 54, Appl
39	70.5	5.4	483	7	US-11-649-663A-5500	Sequence 5500, Ap
40	70	5.4	267	6	US-10-533-069-1272	Sequence 1272, Ap
41	70	5.4	834	7	US-11-551-744-233	Sequence 233, App
42	69.5	5.3	299	7	US-11-649-663A-2878	Sequence 2878, Ap
43	69.5	5.3	331	7	US-11-726-100-3	Sequence 3, Appli
44	69.5	5.3	436	7	US-11-796-730-4125	Sequence 4125, Ap
45	69.5	5.3	468	6	US-10-438-246-32290	Sequence 32290, A

Attachment
Case # 10/724,264

ALIGNMENTS

```
RESULT 1
US-10-438-246-18926
; Sequence 18926, Application US/10438246
; Publication No. US20070192889A1
; GENERAL INFORMATION:
;  APPLICANT: La Rosa, Thomas J.
;  APPLICANT:  Lutfiyya, Linda L.
;  APPLICANT:  Zhou, Yihua
;  APPLICANT:  Kovalic, David K.
;  APPLICANT:  Barbazuk, Brad
;  APPLICANT:  Li, Ping
;  APPLICANT:  Wu, Wei
;  APPLICANT:  Boukharov, Andrey A.
;  TITLE OF INVENTION: Nucleic Acid Molecules and Other Molecules Associated with
;  TITLE OF INVENTION:  Transcription in Plants and Uses Thereof for Plant Improvement
;  FILE REFERENCE: 38-21(53333)B
;  CURRENT APPLICATION NUMBER: US/10/438,246
;  CURRENT FILING DATE:  2003-05-14
;  NUMBER OF SEQ ID NOS: 33516
; SEQ ID NO 18926
;   LENGTH: 1691
;   TYPE: PRT
;   ORGANISM: Oryza sativa
;   FEATURE:
;   OTHER INFORMATION: Clone ID: TF_OSC416395j.C1.p15.fg
US-10-438-246-18926

  Query Match             7.6%;  Score 98.5;  DB 6;  Length 1691;
  Best Local Similarity   22.4%;  Pred. No. 0.022;
  Matches   58;  Conservative   41;  Mismatches   91;  Indels   69;  Gaps   13;

Qy          3 LLLILGSVIALPTF-------AAGGGDLDASDYTG-VSFWLVTAALLASTVFFFVERDRV 54
              |:|   :|| || :        | | | : |   | :| | :   :: | :: |: :  :
Db        126 LVLFCCAVILLPVYIFTTPLLIALGQDPEISAVAGTISLWYI--PVMFSYIWAFMLQMYL 183

Qy         55 SAKWKTSLTVSGLVTGIAFWHYMYMRGVWIETGDSPTVFRYIDWLLTVPLLICEFYLILA 114
               |: |       :|| :||          :  |    :  :: |||||     :| | ||
Db        184 QAQSKNM-----IVTYLAF----------LNLG----IHLFLSWLLTV--:--KFQLGLA 219

Qy        115 AATNVAGSLFKKLLVGSLVMLVFGYMGEAGIMAAWPAFIIGCLAWVYMIYELWAGEGKSA 174
                  | ||:     :     | | : |  |    |  |       :  | :|.   |
Db        220 ---GVMGSMVISFWIPVFGQLAFVFFG--GCPLTWTGFSSSAFTDLGAIMKLSLSSGVML 274

Qy        175 CNTASPAVQSAYNTMMYIIIFGWAIYPVGYFTGYLMGD--GGSALNLNLIY--------- 223
              |      ::  |||:: ::             |||:        ||::.| |
Db        275 C------LELWYNTILVLL------------TGYMKNAEVALDALSICLAYIFTESKAVA 316

Qy        224 -NLADFVNKILFGLIIWNV 241
               :||    : | ::: :|
Db        317 DEVADLAPLLAFSILLNSV 335


RESULT 2
US-10-438-246-25027
; Sequence 25027, Application US/10438246
; Publication No. US20070192889A1
; GENERAL INFORMATION:
;  APPLICANT: La Rosa, Thomas J.
;  APPLICANT:  Lutfiyya, Linda L.
;  APPLICANT:  Zhou, Yihua
```

10/784,264

```
=> d his

     (FILE 'HOME' ENTERED AT 12:26:36 ON 18 SEP 2007)

     FILE 'MEDLINE, EMBASE, BIOSIS, BIOTECHDS, SCISEARCH, HCAPLUS, NTIS,
     LIFESCI' ENTERED AT 12:27:04 ON 18 SEP 2007
L1           318 S PROTEORHODOPSIN
L2            86 S "HISTIDINE 75" OR "HIS75"
L3             0 S L1 AND L2
L4             0 S "H75" AND L1
                 E JENSEN R B/AU
L5           150 S E3
                 E KELEMEN B/AU
L6           102 S E1-E12
L7            10 S L1 AND L6
L8             5 DUP REM L7 (5 DUPLICATES REMOVED)
L9             6 S L1 (W)MUTANT?
L10            2 DUP REM L9 (4 DUPLICATES REMOVED)

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PASSWORD:
TERMINAL (ENTER 1, 2, 3, OR ?):2


* * * * * * * * * *   Welcome to STN International   * * * * * * * * * *

 NEWS  1           Web Page for STN Seminar Schedule - N. America
 NEWS  2  JUL 02   LMEDLINE coverage updated
 NEWS  3  JUL 02   SCISEARCH enhanced with complete author names
 NEWS  4  JUL 02   CHEMCATS accession numbers revised
 NEWS  5  JUL 02   CA/CAplus enhanced with utility model patents from China
 NEWS  6  JUL 16   CAplus enhanced with French and German abstracts
 NEWS  7  JUL 18   CA/CAplus patent coverage enhanced
 NEWS  8  JUL 26   USPATFULL/USPAT2 enhanced with IPC reclassification
 NEWS  9  JUL 30   USGENE now available on STN
 NEWS 10  AUG 06   CAS REGISTRY enhanced with new experimental property tags
 NEWS 11  AUG 06   BEILSTEIN updated with new compounds
 NEWS 12  AUG 06   FSTA enhanced with new thesaurus edition
 NEWS 13  AUG 13   CA/CAplus enhanced with additional kind codes for granted
                   patents
 NEWS 14  AUG 20   CA/CAplus enhanced with CAS indexing in pre-1907 records
 NEWS 15  AUG 27   Full-text patent databases enhanced with predefined
                   patent family display formats from INPADOCDB
 NEWS 16  AUG 27   USPATOLD now available on STN
 NEWS 17  AUG 28   CAS REGISTRY enhanced with additional experimental
                   spectral property data
 NEWS 18  SEP 07   STN AnaVist, Version 2.0, now available with Derwent
                   World Patents Index
 NEWS 19  SEP 13   FORIS renamed to SOFIS
 NEWS 20  SEP 13   INPADOCDB enhanced with monthly SDI frequency
 NEWS 21  SEP 17   CA/CAplus enhanced with printed CA page images from
                   1967-1998
 NEWS 22  SEP 17   CAplus coverage extended to include traditional medicine
                   patents

 NEWS EXPRESS  05 SEPTEMBER 2007:  CURRENT WINDOWS VERSION IS V8.2,
               CURRENT MACINTOSH VERSION IS V6.0c(ENG) AND V6.0Jc(JP),
               AND CURRENT DISCOVER FILE IS DATED 05 SEPTEMBER 2007.

 NEWS HOURS    STN Operating Hours Plus Help Desk Availability
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 NEWS IPC8     For general information regarding STN implementation of IPC 8

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* * * * * * * * * * * * * * * * STN  Columbus  * * * * * * * * * * * * * * * *
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FILE 'HOME' ENTERED AT 12:26:36 ON 18 SEP 2007

=> file medline embase biosis biotechds scisearch hcaplus ntis lifesci
COST IN U.S. DOLLARS                                  SINCE FILE      TOTAL
                                                         ENTRY    SESSION
FULL ESTIMATED COST                                       0.21       0.21

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FILE 'LIFESCI' ENTERED AT 12:27:04 ON 18 SEP 2007
COPYRIGHT (C) 2007 Cambridge Scientific Abstracts (CSA)


=> s proteorhodopsin
L1          318 PROTEORHODOPSIN

=> s "histidine 75" or "his75"
L2           86 "HISTIDINE 75" OR "HIS75"

=> s l1 and l2
L3            0 L1 AND L2

=> s "H75" and l1
L4            0 "H75" AND L1

=> e jensen r b/au
E1           21     JENSEN R A C/AU
E2            1     JENSEN R A JR/AU
E3          150 --> JENSEN R B/AU
E4            5     JENSEN R B B/AU
E5            1     JENSEN R BUGGE/AU
E6          111     JENSEN R C/AU
E7           68     JENSEN R D/AU
E8            2     JENSEN R DUANE/AU
E9          387     JENSEN R E/AU
E10           1     JENSEN R E */AU
E11           1     JENSEN R E V/AU
E12           2     JENSEN R F/AU

=> s e3
L5          150 "JENSEN R B"/AU
```

```
=> e kelemen b/au
E1            9      KELEMEN ARPAD/AU
E2            2      KELEMEN ARPAD G/AU
E3           16 --> KELEMEN B/AU
E4            1      KELEMEN B I/AU
E5           32      KELEMEN B R/AU
E6            1      KELEMEN B S/AU
E7            2      KELEMEN BARBARA/AU
E8            7      KELEMEN BELA/AU
E9            1      KELEMEN BRAD/AU
E10           2      KELEMEN BRADLEY/AU
E11           1      KELEMEN BRADLEY D/AU
E12          28      KELEMEN BRADLEY R/AU

=> s e1-e12
L6          102 ("KELEMEN ARPAD"/AU OR "KELEMEN ARPAD G"/AU OR "KELEMEN B"/AU
                OR "KELEMEN B I"/AU OR "KELEMEN B R"/AU OR "KELEMEN B S"/AU OR
                "KELEMEN BARBARA"/AU OR "KELEMEN BELA"/AU OR "KELEMEN BRAD"/AU
                OR "KELEMEN BRADLEY"/AU OR "KELEMEN BRADLEY D"/AU OR "KELEMEN
                BRADLEY R"/AU)

=> d his

     (FILE 'HOME' ENTERED AT 12:26:36 ON 18 SEP 2007)

     FILE 'MEDLINE, EMBASE, BIOSIS, BIOTECHDS, SCISEARCH, HCAPLUS, NTIS,
     LIFESCI' ENTERED AT 12:27:04 ON 18 SEP 2007
L1           318 S PROTEORHODOPSIN
L2            86 S "HISTIDINE 75" OR "HIS75"
L3             0 S L1 AND L2
L4             0 S "H75" AND L1
                 E JENSEN R B/AU
L5           150 S E3
                 E KELEMEN B/AU
L6           102 S E1-E12

=> s l1 and l6
L7           10 L1 AND L6

=> dup rem l7
PROCESSING COMPLETED FOR L7
L8            5 DUP REM L7 (5 DUPLICATES REMOVED)

=> d 1-5 ibib ab

L8   ANSWER 1 OF 5  HCAPLUS  COPYRIGHT 2007 ACS on STN
ACCESSION NUMBER:         2005:1350774  HCAPLUS
DOCUMENT NUMBER:          144:77689
TITLE:                    Photochromic material comprising a
                          proteorhodopsin apoprotein and retinal analog
INVENTOR(S):              Jensen, Rasmus B.; Kelemen, Bradley; Ward,
                          Donald E., II; Asato, Alfred E.
PATENT ASSIGNEE(S):       Genencor International, Inc., USA; Dow Corning
SOURCE:                   PCT Int. Appl., 35 pp.
                          CODEN: PIXXD2
DOCUMENT TYPE:            Patent
LANGUAGE:                 English
FAMILY ACC. NUM. COUNT:   1
PATENT INFORMATION:

     PATENT NO.           KIND   DATE        APPLICATION NO.         DATE
     ---------------      ----   --------    --------------------    --------
     WO 2005124230         A1    20051229    WO 2005-US20900         20050609
         W:  AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH,
```

CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW

RW: BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG

CA 2569368	A1	20051229	CA 2005-2569368	20050609
EP 1753997	A1	20070221	EP 2005-771676	20050609

R: AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LI, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR

PRIORITY APPLN. INFO.:	US 2004-579180P	P	20040610
	US 2004-622425P	P	20041026
	WO 2005-US20900	W	20050609

OTHER SOURCE(S): MARPAT 144:77689

AB The present invention relates to a photochromic material comprising a proteorhodopsin apoprotein and a retinal analog. In one embodiment, the retinal analog is an azulenic retinoid compound I [R1,R2,R3 = H, C1-4 straight or branched alkyl; n = 1 -4; X1, X2 = H, C1-4 alkyl, F, Cl or CF3; Y = direct bond, p-, m-, or o-phenyl; Z = CHO]. In another embodiment, the retinal analog is other compound that is structurally similarly to all-trans-retinal. The proteorhodopsin apoprotein and the retinal analog form a photochromic material having different spectral properties from those of a corresponding photochromic material formed by the same proteorhodopsin apoprotein and all-trans-retinal. In one embodiment of the application, the retinal analog-containing proteorhodopsin has an absorbance spectrum that does not overlap significantly with that of all-trans-retinal-containing proteorhodopsin. In another embodiment of the application, the retinal analog-containing proteorhodopsin yields a red shifted visual chromophore compared with the all-trans-retinal-containing proteorhodopsin chromophore. The photochromic material of the present invention is useful as an optical data storage carrier, a fraud-proof optical data carrier, security ink, and in other optical applications.

REFERENCE COUNT: 5 THERE ARE 5 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L8 ANSWER 2 OF 5 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER:	2005:1350735 HCAPLUS
DOCUMENT NUMBER:	144:97744
TITLE:	Compositions comprising various proteorhodopsins and/or bacteriorhodopsins and use thereof for photochromic information carrier
INVENTOR(S):	Bott, Richard R.; Jensen, Rasmus B.; Kelemen, Bradley; Ward, Donald E., II; Whited, Gregory M.
PATENT ASSIGNEE(S):	Genencor International, Inc., USA; Dow Corning
SOURCE:	PCT Int. Appl., 36 pp. CODEN: PIXXD2
DOCUMENT TYPE:	Patent
LANGUAGE:	English
FAMILY ACC. NUM. COUNT:	1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2005123110	A2	20051229	WO 2005-US20899	20050609

W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ,

LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA,
NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK,
SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU,
ZA, ZM, ZW
RW: BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW, AM,
AZ, BY, KG, KZ, MD, RU, TJ, TM, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT,
RO, SE, SI, SK, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML,
MR, NE, SN, TD, TG

CA 2569367	A1	20051229	CA 2005-2569367		20050609
EP 1753448	A2	20070221	EP 2005-761082		20050609
R: AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LI, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR, AL, BA, HR, LV, MK, YU					
KR 2007031930	A	20070320	KR 2006-725986		20061208
PRIORITY APPLN. INFO.:			US 2004-579181P	P	20040610
			US 2004-622424P	P	20041026
			WO 2005-US20899	W	20050609

AB The present invention provides a solid material comprising an immobilized mixture of two or more proteorhodopsins, two or more bacteriorhodopsins, or one or more bacteriorhodopsin and one or more proteorhodopsins. The proteorhodopsins are selected from the group consisting of all-trans-retinal-containing proteorhodopsins and retinal analog-containing proteorhodopsins; all of which have absorption spectra that do not overlap. The bacteriorhodopsins are selected from the group consisting of all-trans-retinal- containing bacteriorhodopsins and retinal analog-containing bacteriorhodopsins; all of which have absorption spectra that do not overlap. The present invention also provides an optical information carrier, such as an optical data storage material and a fraud-proof optical data carrier, comprising the above-described solid material and a substrate selected from the group consisting of glass, paper, metal, fabric material, and plastic material, wherein said solid material is deposited on said substrate. The present invention further provides security ink comprising one or more hydrophilic polymers and a mixture of various photochromic materials.

L8 ANSWER 3 OF 5 BIOTECHDS COPYRIGHT 2007 THE THOMSON CORP. on STN
DUPLICATE 1
ACCESSION NUMBER: 2004-18649 BIOTECHDS
TITLE: New proteorhodopsin mutant having improved optical characteristics, useful as a photochromic all-trans-retinal protein for optical storage devices, or in devices for ATP generation in reactors and desalination of sea water; for use in optical data storage, interferometry and/or photonics
AUTHOR: JENSEN R B; KELEMEN B R
PATENT ASSIGNEE: GENENCOR INT INC; DOW CORNING CORP
PATENT INFO: WO 2004063326 29 Jul 2004
APPLICATION INFO: WO 2003-US38194 26 Nov 2003
PRIORITY INFO: US 2002-429518 26 Nov 2002; US 2002-429518 26 Nov 2002
DOCUMENT TYPE: Patent
LANGUAGE: English
OTHER SOURCE: WPI: 2004-544077 [52]

AB DERWENT ABSTRACT:
NOVELTY - A proteorhodopsin mutant having improved optical characteristics and comprising a mutation in a conserved residue of a wild-type proteorhodopsin variant, the proteorhodopsin mutant having lower pKrh or less difference in maximum absorption wavelength between a basic and an acidic form, in comparison with the wild-type proteorhodopsin variant, is new.

DETAILED DESCRIPTION - A proteorhodopsin mutant may be a proteorhodopsin mutant comprising a sequence of 249, 249, 249, 252, 252, 252, 252, 252, 252, 252, or 252 amino acids (SEQ ID NO: 163,

165, 167, 169, 171, 173, 175, 177, 179, 181 or 183, respectively) given in the specification. INDEPENDENT CLAIMS are also included for: (1) an isolated nucleic acid sequence encoding the proteorhodopsin mutant above, or comprising a sequence comprising 750, 750, 750, 756, 756, 756, 756, 756, 756, 756, or 756 bp (SEQ ID NO: 164, 166, 168, 170, 172, 174, 176, 178, 180, 182 or 184, respectively) given in the specification; (2) a method for preparing a proteorhodopsin mutant having improved optical characteristics; (3) a method of storing and retrieving optical data; and (4) a light-driven energy generator comprising the proteorhodopsin mutant above, a cell membrane, a source of all-trans-retinal, and a light source, where the proteorhodopsin mutant integrates within the cell membrane to produce an integrated proteorhodopsin mutant, and the integrated proteorhodopsin mutant binds covalently to all-trans-retinal to produce a light absorbing pigment.

BIOTECHNOLOGY - Preparation (claimed): Preparing a proteorhodopsin mutant having improved optical characteristics comprises identifying a conserved amino acid residue of a wild-type proteorhodopsin variant, mutagenizing the conserved amino acid residue and obtaining proteorhodopsin mutants, determining the optical characteristics of the proteorhodopsin mutants, and selecting the proteorhodopsin mutant having improved optical characteristics. The conserved residue is a conserved histidine or arginine residue. The conserved amino acid residue is mutagenized by site-directed mutagenesis. The improved optical characteristics are lower pKrh or less difference in maximum absorption wavelength between a basic and an acidic form, in comparison with the wild-type proteorhodopsin variant. The wild-type proteorhodopsin variant is a naturally occurring proteorhodopsin variant having a sequence comprising 230-252 amino acids (odd SEQ ID NOs between SEQ ID NO: 1-161) given in the specification, or other proteorhodopsin variants sharing at least 90% amino acid identity to it. The conserved histidine residue is at amino acid position 77 of SEQ ID NO: 1 or at position 75 of a sequence comprising 756 bp (SEQ ID NO: 2) also given in the specification. The proteorhodopsin mutant has a lower pKrh in comparison with the wild-type proteorhodopsin variant. The conserved histidine residue is mutated to an amino acid capable of forming a hydrogen bond, where such amino acid is asparagine, glutamine, lysine, arginine, tryptophan, serine, threonine, tyrosine, aspartic acid or glutamic acid, preferably asparagine, glutamine, lysine, tryptophan, aspartic acid, or glutamic acid. The conserved arginine residue is at amino acid position 96 or 94 of SEQ ID NO:1 or 2, respectively. the proteorhodopsin mutant may have less difference in maximum absorption wavelengths between a basic and an acidic form, in comparison with the proteorhodopsin variant. The conserved arginine residue is mutated to alanine, glutamic acid or glutamine. Preferred Method: Storing and retrieving optical data comprises: (a) providing a film comprising a matrix having the proteorhodopsin mutant above immobilized within; (b) exposing the film to light of a wavelength that is absorbed by the proteorhodopsin mutant at a resting state in a predetermined pattern; (c) converting selective portions of the film to an excited state and storing optical data in it; (d) exposing the file of step (c) to light of a wavelength that is absorbed by the proteorhodopsin mutant at either a resting state or an excited state; and (e) detecting the stored optical data by an optical recording device.

USE - The proteorhodopsin mutant can be incorporated into instruments or devices having photochromic applications (e.g., for optical data storage, interferometry and/or photonics), photoelectric applications, and/or phototransport applications. The proteorhodopsin mutant is useful as a photochromic all-trans-retinal protein for optical storage devices, in devices for information storage such as 2-D storage, 3-D storage, holographic storage, or associative storage. The proteorhodopsin mutant is

useful in a device for information processing such as optical bistability/light switching, optical filtering, signal conditioning, neural networks, spatial light modulators, phase conjugation, pattern recognition, interferometry or the like. The proteorhodopsin mutant is useful in devices for ATP generation in reactors, desalination of sea water, and/or conversion of sunlight into electricity. Furthermore, the proteorhodopsin mutant is useful as a replacement for bacteriorhodopsin for a variety of devices/processes that utilize bacteriorhodopsin, e.g., protein-enzyme biochemical optical recording medium and imaging process.

EXAMPLE - No relevant example given.(316 pages)

L8 ANSWER 4 OF 5 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 2004:467948 HCAPLUS
DOCUMENT NUMBER: 141:25187
TITLE: Optical information carrier comprising immobilized proteorhodopsin, security ink, and preparation
INVENTOR(S): Jensen, Rasmus B.; Kelemen, Bradley R.; McAuliffe, Joseph C.; Smith, Wyatt C.
PATENT ASSIGNEE(S): Genencor International, Inc., USA; Dow Corning Corporation
SOURCE: PCT Int. Appl., 37 pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2004048451	A2	20040610	WO 2003-US38157	20031126
WO 2004048451	A3	20060216		
W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW				
RW: BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG				
CA 2507165	A1	20040610	CA 2003-2507165	20031126
AU 2003298777	A1	20040618	AU 2003-298777	20031126
US 2005095605	A1	20050505	US 2003-724264	20031126
EP 1576042	A2	20050921	EP 2003-796535	20031126
R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, LV, FI, RO, MK, CY, AL, TR, BG, CZ, EE, HU, SK				
JP 2006515683	T	20060601	JP 2004-555825	20031126

PRIORITY APPLN. INFO.:
US 2002-429518P P 20021126
WO 2003-US38157 W 20031126

AB The materials comprise hydrophilic polymers and immobilized proteorhodopsin. The material comprises ≥1 hydrophilic polymers that form a homogeneous phase with proteorhodopsin prior to solidification to a solid form. The hydrophilic polymer may be SiO2 sol-gel, gelatin, poly(vinyl alc.), agarose, agar, Me cellulose, polyvinyl acetate, polyvinyl pyrrolidone, polyethylene glycol, or a mixture The solid material having immobilized proteorhodopsin is deposited on a substrate selected from glass, paper, metal, fabric material, plastic material, and used as an optical data storage material or a fraud-proof carrier. A security ink may also comprise proteorhodopsin and ≥1 hydrophilic polymers.

L8 ANSWER 5 OF 5 MEDLINE on STN DUPLICATE 2

ACCESSION NUMBER: 2003565238 MEDLINE
DOCUMENT NUMBER: PubMed ID: 14643930
TITLE: Proteorhodopsin in living color: diversity of spectral properties within living bacterial cells.
AUTHOR: Kelemen Bradley R; Du Mai; Jensen Rasmus B
CORPORATE SOURCE: Genencor International, Inc, 925 Page Mill Road, Palo Alto, CA 94304, USA.
SOURCE: Biochimica et biophysica acta, (2003 Dec 3) Vol. 1618, No. 1, pp. 25-32.
Journal code: 0217513. ISSN: 0006-3002.
PUB. COUNTRY: Netherlands
DOCUMENT TYPE: Journal; Article; (JOURNAL ARTICLE)
(RESEARCH SUPPORT, NON-U.S. GOV'T)
LANGUAGE: English
FILE SEGMENT: Priority Journals
ENTRY MONTH: 200401
ENTRY DATE: Entered STN: 16 Dec 2003
Last Updated on STN: 21 Jan 2004
Entered Medline: 20 Jan 2004

AB Proteorhodopsin is a family of over 50 proteins that provide phototrophic capability to marine bacteria by acting as light-powered proton pumps. The potential importance of proteorhodopsin to global ocean ecosystems and the possible applications of proteorhodopsin in optical data storage and optical signal processing have spurred diverse research in this new family of proteins. We show that proteorhodopsin expressed in Escherichia coli is functional and properly inserted in the membrane. At high expression levels, it appears to self-associate. We present a method for determining spectral properties of proteorhodopsin in intact E. coli cells that matches results obtained with detergent-solubilized, purified proteins. Using this method, we observe distinctly different spectra for protonated and deprotonated forms of 21 natural proteorhodopsin proteins in intact E. coli cells. Upon protonation, the wavelength maxima red shifts between 13 and 53 nm. We find that pKa values between 7.1 and 8.5 describe the pH-dependent spectral shift for all of the 21 natural variants of proteorhodopsin. The wavelength maxima of the deprotonated forms of the 21 natural proteorhodopsins cluster in two sequence-related groups: blue proteorhodopsins (B-PR) and green proteorhodopsins (G-PR). The site-directed substitution Leu105Gln in Bac31A8 proteorhodopsin shifts this G-PR's wavelength maximum to a wavelength maximum the same as that of the B-PR Hot75m1 proteorhodopsin. The site-directed substitution Gln107Leu in Hot75m1 proteorhodopsin shifts this B-PR's wavelength maximum to a wavelength maximum as that of Bac31A8 proteorhodopsin.

=> d his

(FILE 'HOME' ENTERED AT 12:26:36 ON 18 SEP 2007)

FILE 'MEDLINE, EMBASE, BIOSIS, BIOTECHDS, SCISEARCH, HCAPLUS, NTIS, LIFESCI' ENTERED AT 12:27:04 ON 18 SEP 2007

L1 318 S PROTEORHODOPSIN
L2 86 S "HISTIDINE 75" OR "HIS75"
L3 0 S L1 AND L2
L4 0 S "H75" AND L1
E JENSEN R B/AU
L5 150 S E3
E KELEMEN B/AU
L6 102 S E1-E12
L7 10 S L1 AND L6
L8 5 DUP REM L7 (5 DUPLICATES REMOVED)

```
=> s l1 (w)mutant2
2 IS NOT A RECOGNIZED COMMAND
The previous command name entered was not recognized by the system.
For a list of commands available to you in the current file, enter
"HELP COMMANDS" at an arrow prompt (=>).

=> s l1 (w)mutant?
L9            6 L1 (W) MUTANT?

=> dup rem l9
PROCESSING COMPLETED FOR L9
L10           2 DUP REM L9 (4 DUPLICATES REMOVED)

=> d 1-2 ibib ab

L10  ANSWER 1 OF 2     MEDLINE on STN                    DUPLICATE 1
ACCESSION NUMBER:    2007520267     IN-PROCESS
DOCUMENT NUMBER:     PubMed ID: 16808594
TITLE:               Photoisomerization in proteorhodopsin
                     mutant D97N.
AUTHOR:              Lenz Martin O; Woerner Andreas C; Glaubitz Clemens;
                     Wachtveitl Josef
CORPORATE SOURCE:    Institute for Physical and Theoretical Chemistry, Johann
                     Wolfgang Goethe-Universitat Frankfurt, Germany.
SOURCE:              Photochemistry and photobiology, (2007 Mar-Apr) Vol. 83,
                     No. 2, pp. 226-31.
                     Journal code: 0376425. ISSN: 0031-8655.
PUB. COUNTRY:        United States
DOCUMENT TYPE:       Journal; Article; (JOURNAL ARTICLE)
                     (RESEARCH SUPPORT, NON-U.S. GOV'T)
LANGUAGE:            English
FILE SEGMENT:        NONMEDLINE; IN-PROCESS; NONINDEXED; Priority Journals
ENTRY DATE:          Entered STN: 7 Sep 2007
                     Last Updated on STN: 7 Sep 2007
AB   The first steps of the photocycle of the D97N mutant of proteorhodopsin
     (PR) have been investigated by means of ultrafast transient absorption
     spectroscopy. A comparison with the primary dynamics of native PR and
     D85N mutant of bacteriorhodopsin is given. Upon photoexcitation of the
     covalently bound all-trans retinal the excited state decays
     biexponentially with time constants of 1.4 and 20 ps via a conical
     intersection, resulting in a 13-cis isomerized retinal. Neither of the
     two-deactivation channels is significantly preferred. The dynamics is
     slowed down in comparison with native PR at pH 9 and reaction rates are
     even lower than for native PR at pH 6, where the primary proton acceptor
     (Asp97) is protonated. Therefore, the ultrafast isomerization is not only
     controlled by the charge distribution within the retinal binding pocket.
     This study shows that in addition to direct electrostatics other effects
     have to be taken into account to explain the catalytic function of Asp97
     in PR on the ultrafast isomerization reaction. This may include sterical
     interactions and/or bound water molecules within the retinal binding
     pocket.

L10   ANSWER 2 OF 2  BIOTECHDS COPYRIGHT 2007 THE THOMSON CORP. on STN
      DUPLICATE 2
ACCESSION NUMBER: 2004-18649  BIOTECHDS
TITLE:            New proteorhodopsin mutant having
                  improved optical characteristics, useful as a photochromic
                  all-trans-retinal protein for optical storage devices, or in
                  devices for ATP generation in reactors and desalination of
                  sea water;
                     for use in optical data storage, interferometry and/or
                     photonics
AUTHOR:           JENSEN R B; KELEMEN B R
PATENT ASSIGNEE:  GENENCOR INT INC; DOW CORNING CORP
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PATENT INFO: WO 2004063326 29 Jul 2004
APPLICATION INFO: WO 2003-US38194 26 Nov 2003
PRIORITY INFO: US 2002-429518 26 Nov 2002; US 2002-429518 26 Nov 2002
DOCUMENT TYPE: Patent
LANGUAGE: English
OTHER SOURCE: WPI: 2004-544077 [52]
AB DERWENT ABSTRACT:
NOVELTY - A proteorhodopsin mutant having improved optical characteristics and comprising a mutation in a conserved residue of a wild-type proteorhodopsin variant, the proteorhodopsin mutant having lower pKrh or less difference in maximum absorption wavelength between a basic and an acidic form, in comparison with the wild-type proteorhodopsin variant, is new.

DETAILED DESCRIPTION - A proteorhodopsin mutant may be a proteorhodopsin mutant comprising a sequence of 249, 249, 249, 252, 252, 252, 252, 252, 252, 252, or 252 amino acids (SEQ ID NO: 163, 165, 167, 169, 171, 173, 175, 177, 179, 181 or 183, respectively) given in the specification. INDEPENDENT CLAIMS are also included for: (1) an isolated nucleic acid sequence encoding the proteorhodopsin mutant above, or comprising a sequence comprising 750, 750, 750, 756, 756, 756, 756, 756, 756, 756, or 756 bp (SEQ ID NO: 164, 166, 168, 170, 172, 174, 176, 178, 180, 182 or 184, respectively) given in the specification; (2) a method for preparing a proteorhodopsin mutant having improved optical characteristics; (3) a method of storing and retrieving optical data; and (4) a light-driven energy generator comprising the proteorhodopsin mutant above, a cell membrane, a source of all-trans-retinal, and a light source, where the proteorhodopsin mutant integrates within the cell membrane to produce an integrated proteorhodopsin mutant, and the integrated proteorhodopsin mutant binds covalently to all-trans-retinal to produce a light absorbing pigment.

BIOTECHNOLOGY - Preparation (claimed): Preparing a proteorhodopsin mutant having improved optical characteristics comprises identifying a conserved amino acid residue of a wild-type proteorhodopsin variant, mutagenizing the conserved amino acid residue and obtaining proteorhodopsin mutants, determining the optical characteristics of the proteorhodopsin mutants, and selecting the proteorhodopsin mutant having improved optical characteristics. The conserved residue is a conserved histidine or arginine residue. The conserved amino acid residue is mutagenized by site-directed mutagenesis. The improved optical characteristics are lower pKrh or less difference in maximum absorption wavelength between a basic and an acidic form, in comparison with the wild-type proteorhodopsin variant. The wild-type proteorhodopsin variant is a naturally occurring proteorhodopsin variant having a sequence comprising 230-252 amino acids (odd SEQ ID NOs between SEQ ID NO: 1-161) given in the specification, or other proteorhodopsin variants sharing at least 90% amino acid identity to it. The conserved histidine residue is at amino acid position 77 of SEQ ID NO: 1 or at position 75 of a sequence comprising 756 bp (SEQ ID NO: 2) also given in the specification. The proteorhodopsin mutant has a lower pKrh in comparison with the wild-type proteorhodopsin variant. The conserved histidine residue is mutated to an amino acid capable of forming a hydrogen bond, where such amino acid is asparagine, glutamine, lysine, arginine, tryptophan, serine, threonine, tyrosine, aspartic acid or glutamic acid, preferably asparagine, glutamine, lysine, tryptophan, aspartic acid, or glutamic acid. The conserved arginine residue is at amino acid position 96 or 94 of SEQ ID NO:1 or 2, respectively. the proteorhodopsin mutant may have less difference in maximum absorption wavelengths between a basic and an acidic form, in comparison with the proteorhodopsin variant. The conserved arginine residue is mutated to alanine, glutamic acid or glutamine. Preferred

Method: Storing and retrieving optical data comprises: (a) providing a film comprising a matrix having the proteorhodopsin mutant above immobilized within; (b) exposing the film to light of a wavelength that is absorbed by the proteorhodopsin mutant at a resting state in a predetermined pattern; (c) converting selective portions of the film to an excited state and storing optical data in it; (d) exposing the file of step (c) to light of a wavelength that is absorbed by the proteorhodopsin mutant at either a resting state or an excited state; and (e) detecting the stored optical data by an optical recording device.

USE - The proteorhodopsin mutant can be incorporated into instruments or devices having photochromic applications (e.g., for optical data storage, interferometry and/or photonics), photoelectric applications, and/or phototransport applications. The proteorhodopsin mutant is useful as a photochromic all-trans-retinal protein for optical storage devices, in devices for information storage such as 2-D storage, 3-D storage, holographic storage, or associative storage. The proteorhodopsin mutant is useful in a device for information processing such as optical bistability/light switching, optical filtering, signal conditioning, neural networks, spatial light modulators, phase conjugation, pattern recognition, interferometry or the like. The proteorhodopsin mutant is useful in devices for ATP generation in reactors, desalination of sea water, and/or conversion of sunlight into electricity. Furthermore, the proteorhodopsin mutant is useful as a replacement for bacteriorhodopsin for a variety of devices/processes that utilize bacteriorhodopsin, e.g., protein-enzyme biochemical optical recording medium and imaging process.

EXAMPLE - No relevant example given.(316 pages)

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=> d his

     (FILE 'HOME' ENTERED AT 12:26:36 ON 18 SEP 2007)

     FILE 'MEDLINE, EMBASE, BIOSIS, BIOTECHDS, SCISEARCH, HCAPLUS, NTIS,
     LIFESCI' ENTERED AT 12:27:04 ON 18 SEP 2007
L1           318 S PROTEORHODOPSIN
L2            86 S "HISTIDINE 75" OR "HIS75"
L3             0 S L1 AND L2
L4             0 S "H75" AND L1
               E JENSEN R B/AU
L5           150 S E3
               E KELEMEN B/AU
L6           102 S E1-E12
L7            10 S L1 AND L6
L8             5 DUP REM L7 (5 DUPLICATES REMOVED)
L9             6 S L1 (W)MUTANT?
L10            2 DUP REM L9 (4 DUPLICATES REMOVED)
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	Document ID	Kind Codes	Source	Issue Date	Pages	Title
1	US 20050095605 A1		US-PGPUB	20050505	241	Proteorhodopsin mutants with improved optical characteristics
2	US 20040223323 A1		US-PGPUB	20041111	20	Optical information carrier comprising immobilized proteorhodopsin

	Document ID	Kind Codes	Source	Issue Date	Pages	Title
1	US 20060240423 A1		US-PGPUB	20061026	79	Isolation and cloning of dna from uncultivated organisms
2	US 20050250128 A1		US-PGPUB	20051110	26	Membranes incorporating recognition moieties
3	US 20050148762 A1		US-PGPUB	20050707	13	Rapid and inexpensive method for the purification of proteorhodopsin
4	US 20050095605 A1		US-PGPUB	20050505	241	Proteorhodopsin mutants with improved optical characteristics
5	US 20040223323 A1		US-PGPUB	20041111	20	Optical information carrier comprising immobilized proteorhodopsin
6	US 20030104375 A1		US-PGPUB	20030605	349	Light-driven energy generation using proteorhodopsin
7	US 7253268 B2		USPAT	20070807	215	Light-driven energy generation using proteorhodopsin

	Document ID	Kind Codes	Source	Issue Date	Pages	Title
1	US 20050095605 A1		US-PGPUB	20050505	241	Proteorhodopsin mutants with improved optical characteristics
2	US 20040223323 A1		US-PGPUB	20041111	20	Optical information carrier comprising immobilized proteorhodopsin

	L #	Hits	Search Text
1	L1	168	"his75" or "h75" or "histidine 75"
2	L2	7	proteorhodopsin$2
3	L3	1	l1 same l2
4	L4	2	l2 adj (mutant? or variant?)
5	L5	354447	JENSEN KELEMEN
6	L6	2	l2 and l5